Long-Small (LS)
Decay Search Analysis

R. Rameika

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Outline

- General Comments on Decay Searches

- LS Analysis Strategy

- Analysis Results

- Next Steps
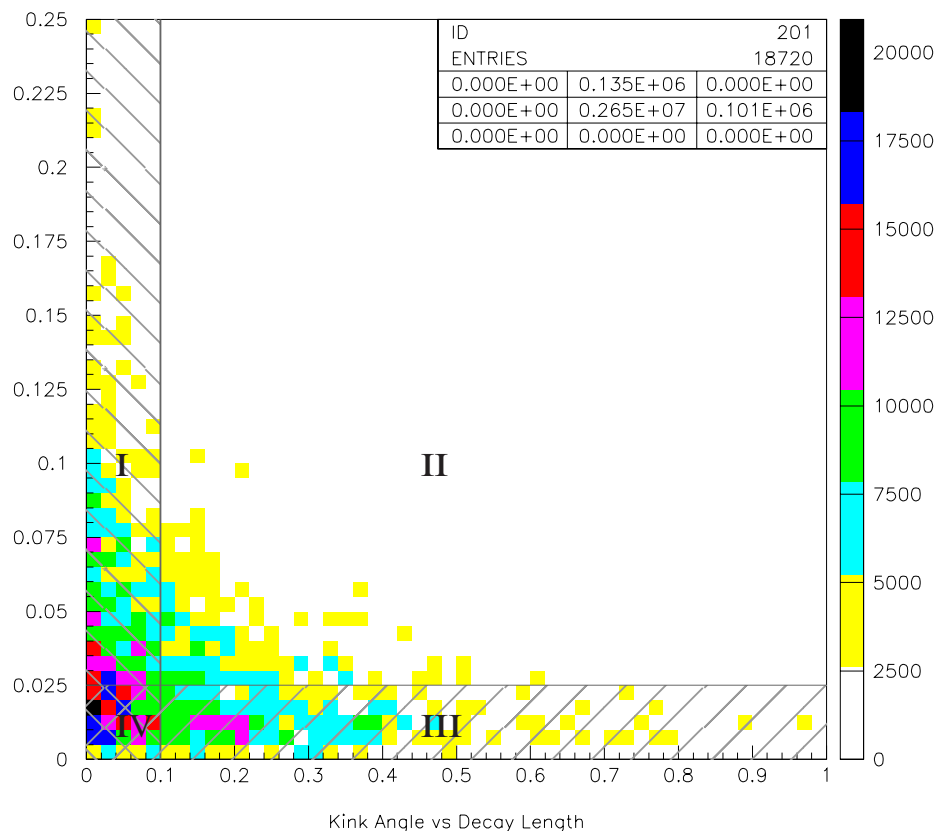
Decay Search Parameters

A τ decay is characterized by two parameters :

1) the length of the parent, L_{dec}

2) the parent-daughter kink angle, θ_{kink}

These two parameters are correlated :

Kink Angle vs Decay Length

Decay Search Regions

Region I : $L_{\text{dec}} \leq 1$ mm

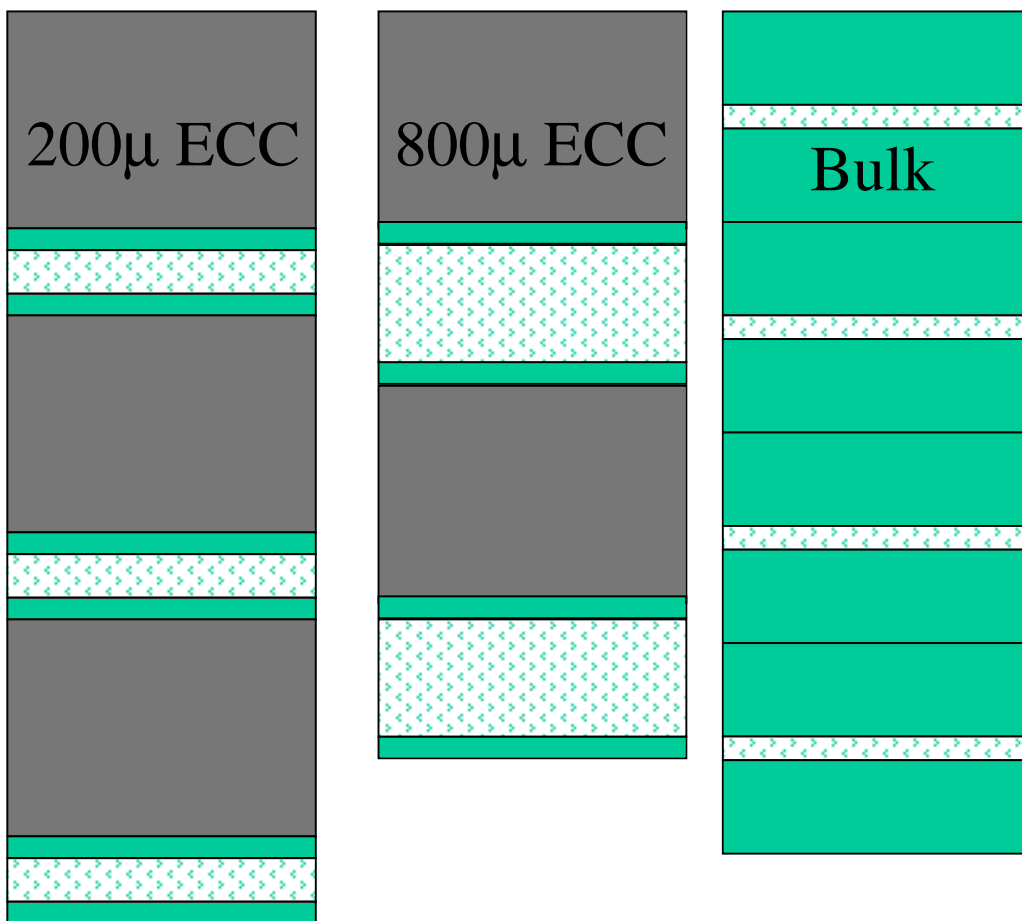Region II : $L_{\text{dec}} \geq 1$ mm; $\theta_{\text{kink}} \geq 25$ mrad

Region III : $L_{\text{dec}} \geq 1$ mm; $\theta_{\text{kink}} \leq 25$ mrad

Emulsion Modules

Don't forget… there are 3 different
configurations of modules...
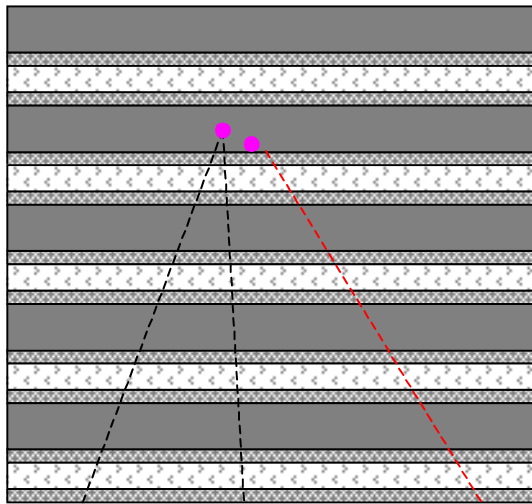
| 200µ ECC | 800µ ECC | Bulk |

So… be careful when relating discussion
and coding of segment dependent algorithms
to physical decay lengths.

Region I (S)

S $\Rightarrow$ short parent

- no segments on the parent
- daughter is "linked" to the parent
  by an impact parameter

Daughter candidates are found by searching
the *m-file* for tracks with impact parameters
$$20\mu \leq IP \leq 500\mu$$
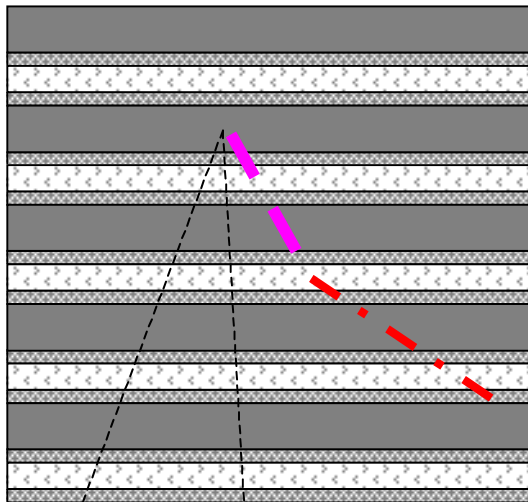and which do not penetrate to plates
upstream of the primary vertex.

Region II (LL)

LL ⇒ long parent, large angle

- parent and daughter are unique tracks
- daughter is "linked" to the parent by a small impact parameter

Daughter candidates are found by searching the *m-file* for tracks which start downstream of a primary track which stops and has a small impact parameter (?μ) with that primary.

Region III (LS)

LS $\Rightarrow$ long parent, small angle

- parent and daughter are merged as a single track
- daughter is "found" by finding a better kink fit than straight track
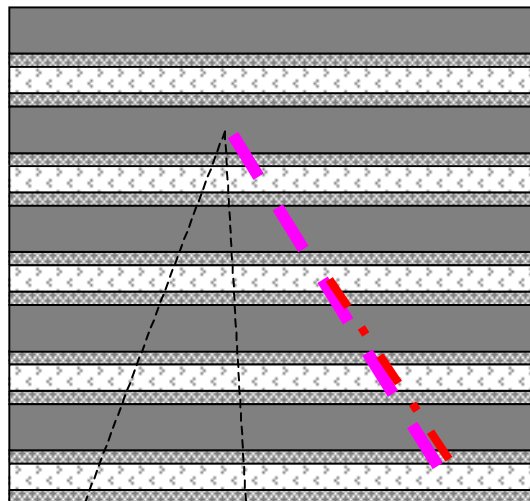
Daughter candidates are found by searching for kinks in each track which has been labeled as coming from the primary.

LS Search Method

- **Limitation :**
  - Intrinsic angular resolution of tracks created from emulsion track segments.
  - Study this using penetrating tracks.

- **Step 1**
  - Use segment coordinates to do a least-squares fit to get track angles
  - Look at distribution of segments about the fitted slopes
  - Also determine track slopes simply by averaging the segment slopes.
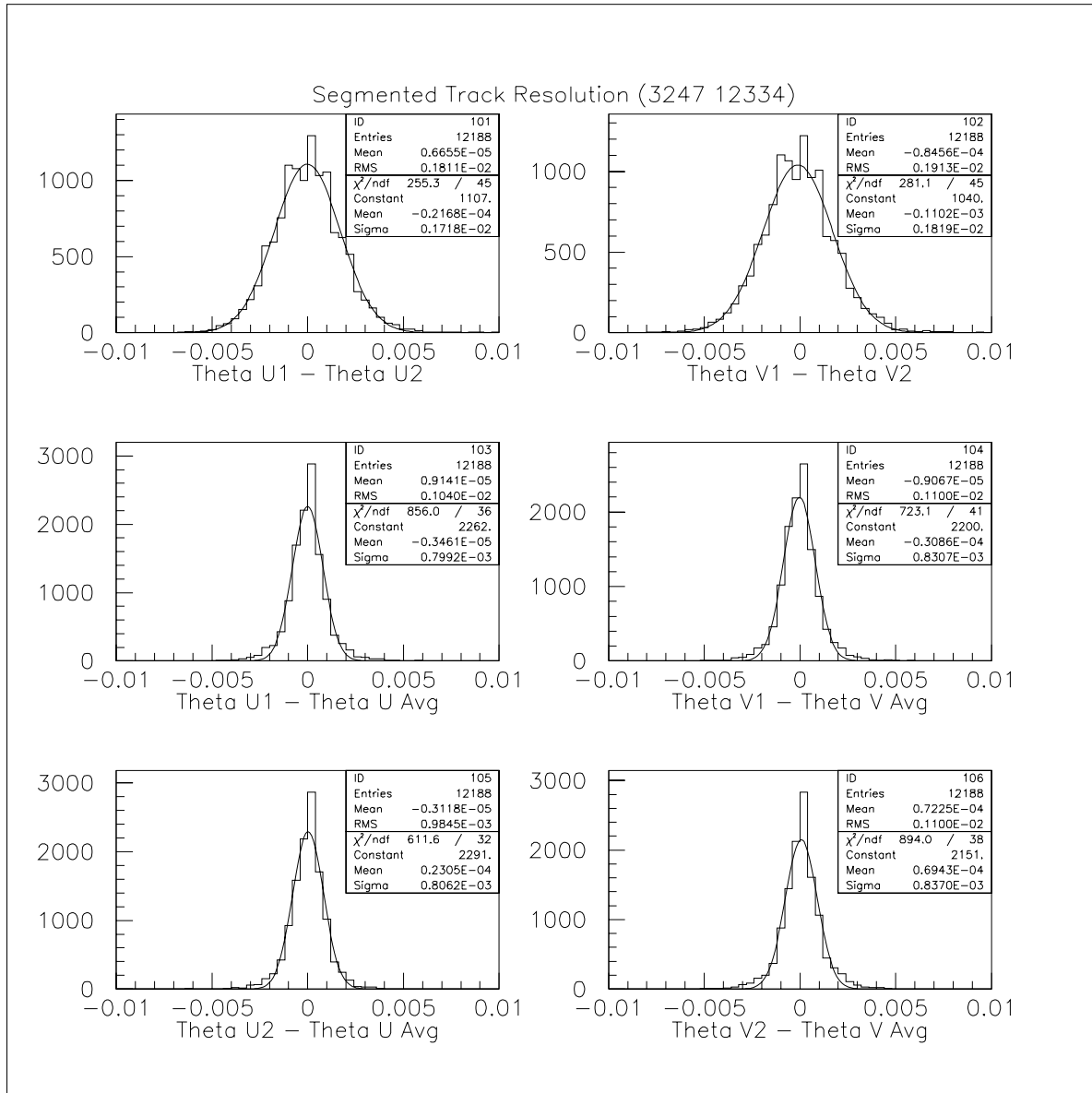 - Compare the difference between the fit and the average.

Track Segments vs. Fit

Through Going Track/Segment Fits (all points) (3247 12334)
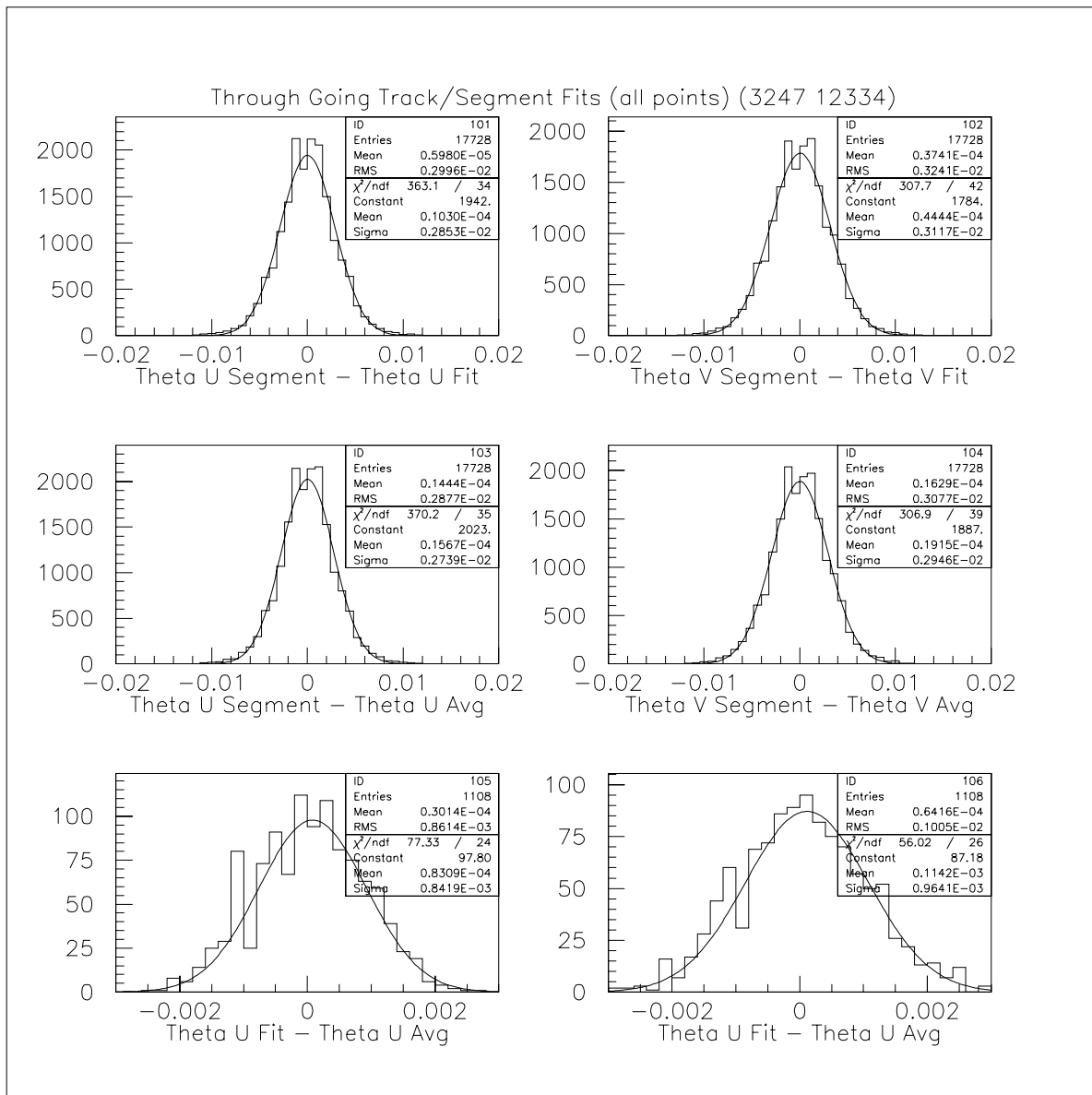
LS Search

- Step 2
  - Segment single long tracks into 2 tracks.
  - Loop over all combinations on lengths
    - 1 / n-1
    - 2 / n-2
    -
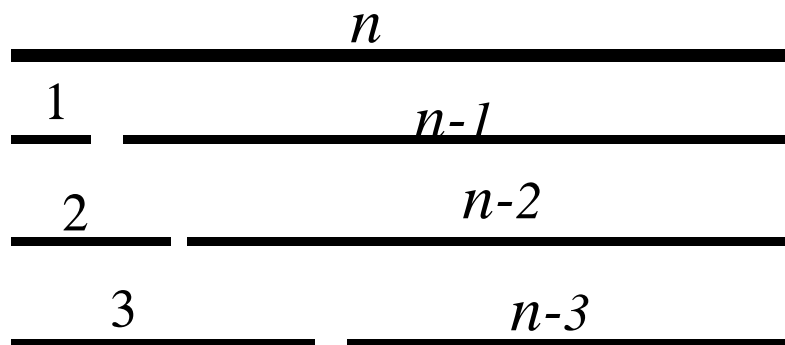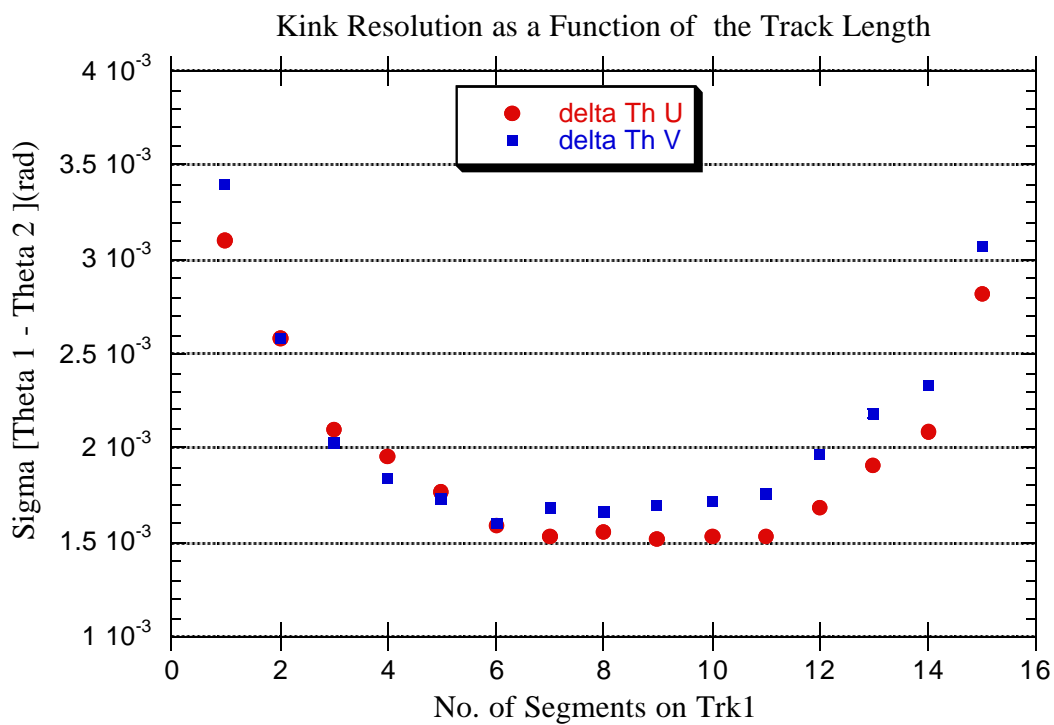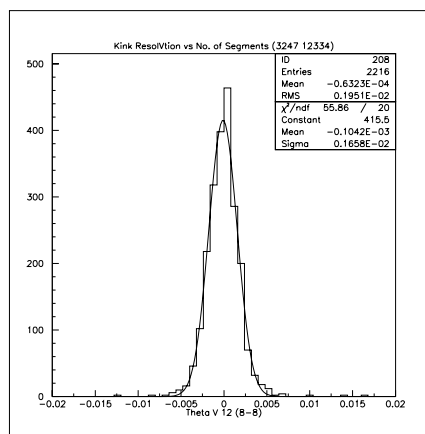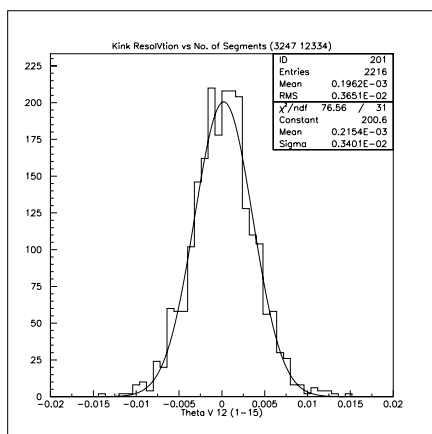   -
    - n-1 / 1

Segmented tracks

Segmented Track Resolution (3247 12334)

E-872

Step 3 : Determine resolution as a function
of the length of the track (i.e. # of segments).

$$n$$

$$1$$

$$n-1$$

$$2$$

$$n-2$$

$$3$$
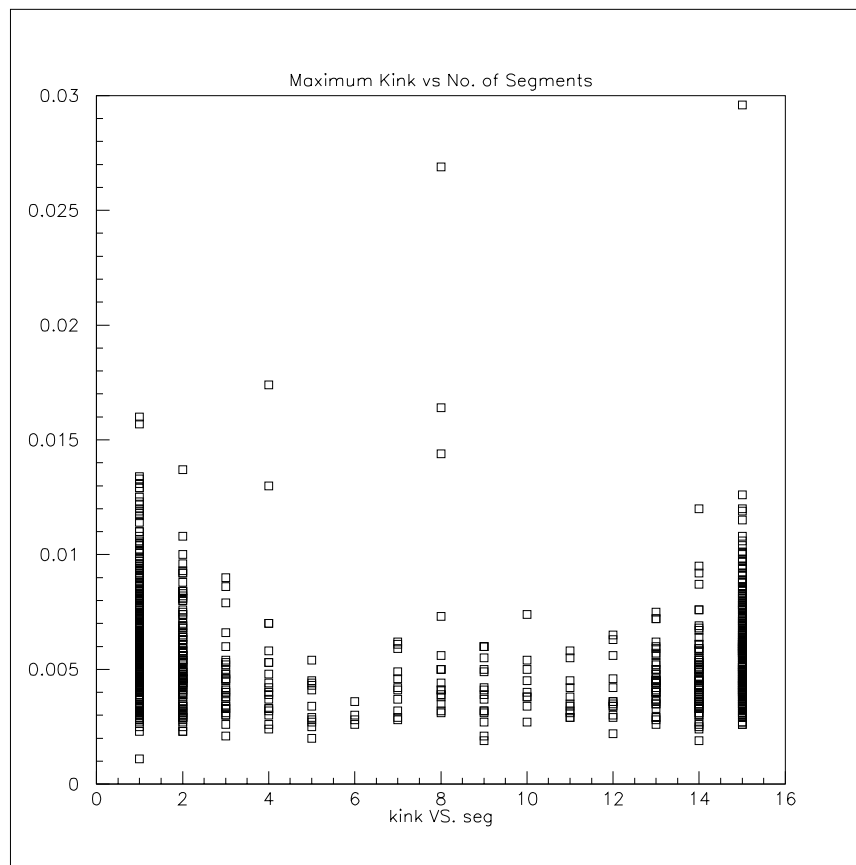
$$n-3$$

Distribution of σ's

Kink Resolution as a Function of the Track Length

Step 4 : Determine sensitivity to real kinks vs. resolution

(For each track, determine the pair of segments making the maximum kink; plot the angle vs. the length of the 1st segment.)

Maximum Kink vs No. of Segments

Next Steps

Code algorithm and establish criteria for selecting candidate kinks.

Using newly created *decay m-files*, select several multi-prong, located events and do a small angle search on each of the primary tracks.

Try matching candidate daughter tracks to the spectrometer tracks.